

TROMBICULID MITES OF THE GENUS *MICROTROMBICULA* (ACARINA) FROM COSTA RICA

JAMES P. WEBB, JR.¹ AND RICHARD B. LOOMIS²

ABSTRACT: Five species of *Microtrombicula* are reported for the first time from Costa Rica: *M. perplexa*, new species, type host *Liomys salvini*, from Guanacaste Province, Costa Rica and from Nicaragua; *M. starretti*, new species, type host *Myotis nigricans*, from Heredia Province, Costa Rica; *M. sturnirae*, new species, type host *Sturnira lilium*, from Chinandega, Nicaragua, Costa Rica, and Mexico; *M. boneti* (Hoffmann) NEW COMBINATION (*Trombicula tibbettsi* Brennan and White, NEW SYNONYMY) from bats of southern United States to Trinidad; and *M. carmenae* (Brennan and Jones) NEW COMBINATION, from bats of southern Mexico to Trinidad. A key to the larvae is included.

INTRODUCTION

This is the second report of trombiculid mites from Costa Rica obtained by field parties of the Los Angeles County Museum of Natural History. Geest and Loomis (1968) listed 13 species, 9 of which were new, of *Pseudoschoenogastia* from approximately 291 of more than 500 examined rodents, taken between January 1962 and December 1964. They also discussed the biotic districts and provinces and the 24 localities where larvae of *Pseudoschoenogastia* had been found.

Described below are five species of *Microtrombicula*, including three new species and two new combinations, all reported from Costa Rica for the first time. Four species are recorded from bats and the fifth is known only from the heteromyid rodent, *Liomys salvini* (Thomas). In addition to the Costa Rican specimens, larvae are reported from southern United States, Mexico, Nicaragua, Panama and Trinidad.

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¹Dept. Biol., California State College, Long Beach, California 90801.

²Dept. Biol., California State College, Long Beach, California 90801; and Research Associate, Los Angeles County Museum of Natural History.

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ACCOUNTS OF THE TAXA

The description of each new species is based upon the holotype, augmented by paratypes. Previously named species are redescribed on the basis of specimens examined. The terminology generally follows Wharton et al. (1951), Wharton and Fuller (1952), and Audy (1954). All measurements are in microns. A key to the species is included.

Except for the specimens from the Rocky Mountain Lab (RML), the specimens from Costa Rica, including all holotypes, are in the Los Angeles County Museum of Natural History (LACM), and the other larvae are in the chigger research collection at California State College, Long Beach. Paratypes will be given to the chigger research collection, California State College, Long Beach; Rocky Mountain Laboratory, Hamilton, Montana; United States National Museum; Institute of Acarology, Ohio State University; The B. P. Bishop Museum, Honolulu, Hawaii; and to other appropriate institutions and individuals.

Subclass ACARINA

Order Acariformes

Suborder Prostigmata

Family Trombiculidae

Subfamily Trombiculinae

Microtrombicula Ewing, 1950

Microtrombicula: Webb and Loomis 1970:655 (Diagnosis of genus)

Species known from Costa Rica: *Trombicula boneti* Hoffmann (= *T. tibbettsi* Brennan and White); *T. carmenae* Brennan and Jones, *Microtrombicula perplexa*, new species; *M. starretti*, new species and *M. sturnirae*, new species.

Diagnosis of Costa Rican species. Pretarsala II present; palpotarsus with six branched and nude setae; palpotibial claw trifurcate or bifurcate; 2-3 genualae I; 2-3 pairs of sternal setae; coxa III with 1-4 setae; galeala nude or branched; sensilla flagelliform or with shaft slightly expanded; scutum moderately punctate; and tarsus III usually with proximal whorl of 3 setae (1 nude or nearly nude dorsal mastitarsala and 2 ventral branched setae) and with media whorl usually of 5 branched setae.

Remarks. Subgenera have not been included as none of these species clearly belongs to any of the recognized categories.

Microtrombicula perplexa, new species

Figures 1, 4

Types. Larvae: Holotype and 95 paratypes from 7.5 km S Liberia, 125 m, Guanacaste Province, Costa Rica, off *Liomys salvini* Thomas, Salvin's spiny pocket mouse, original number 0-3296 (LACM 26609), taken 8 August 1964 by C. L. Hogue, R. C. Stephens and J. C. Geest.

Diagnosis. Larva similar to *M. crossleyi* (Loomis) and *M. trisetica* (Loomis and Crossley) in having coxa III with multiple setae (2-4); sternal setae 2-2-2; and palpotibial claw bifurcate, and differing from both in having 2 rather than 3 genualae I, sensilla with shaft slightly expanded instead of flagelliform, mastitarsala III branched rather than nude, and eyes absent.

Description of holotype (with mean and range of 14 types, holotype and 13 paratypes, in parentheses, unless otherwise noted). Body slightly engorged, 220 by 155, eyes absent.

Dorsal setae 2-10-10-10-8-8 + 20, total 68; measurements of humeral seta 31, anterior dorsal seta 21, posterior dorsal seta 38.

Ventral setae 2-2-2 (sternals) 6-4-6 + 30, total 52; measurements of anterosternal seta 20, posterosternal seta 20, posterior ventral seta 38.

Scutum: Subpentagonal, moderately punctate; sensilla slightly expanded with numerous setules along entire length.

Scutal measurements: AW 59 (61, 59-62; 13), PW 73 (76.5, 73-80), SB 23 (24, 23-25), ASB 24 (24, 22-26), PSB 28 (26, 24-29), AP 19 (19, 16-22), AM 25 (27, 25-30), AL 26 (26, 23-29; 13), PL 28 (29, 28-31), S 47 (48, 32-52; 12).

Gnathosoma: Cheliceral blade with small tricuspid cap and elongate, pointed dorsal projection; cheliceral base and capitular sternum with moderate punctuation. Galeala nude. Palpal setae B/B/BNB (palpotibial setae with few branches); palpotarsus with 1 nude and 5 branched setae, and tarsala 6; palpotibial claw bifurcate.

Leg I, 2 genualae, tarsala 14 (14, 13-16); leg II, tarsala 13 (13, 13-14), proximal microtarsala, and pretarsala; leg III, coxa with 2-4 (usually 3) branched setae, and mastitarsala with several branches.

Leg measurements: I, 190 (203, 190-218); II, 182 (177, 166-186); III, 199 (192, 182-204); total, 571 (575, 550-598).

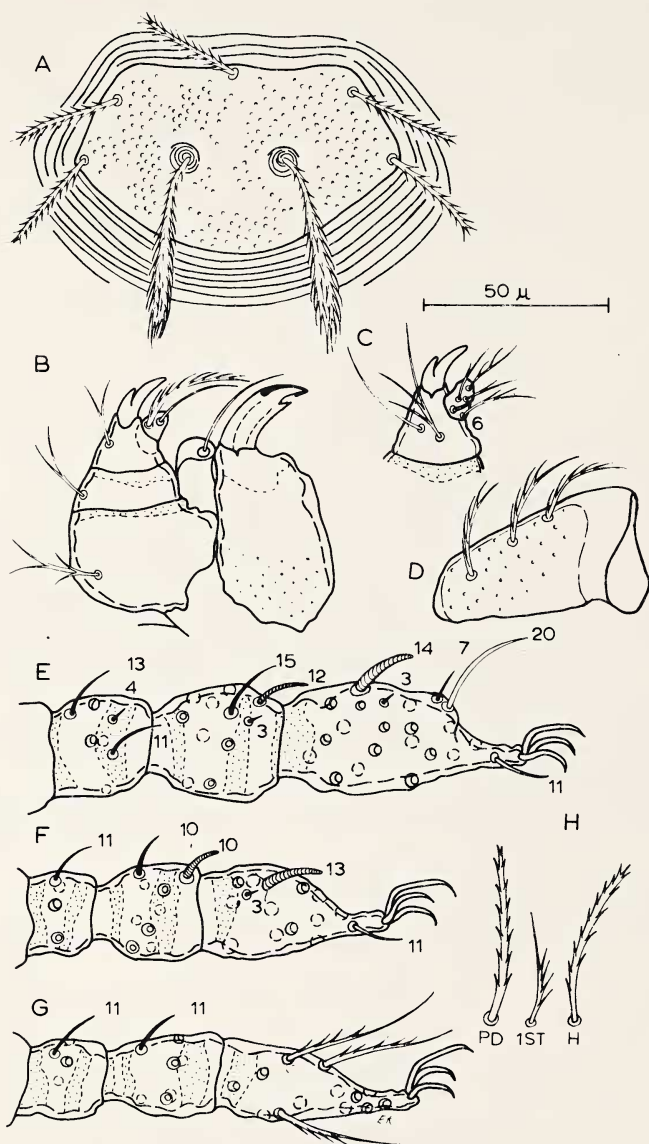


FIGURE 1. *Microtrombicula perplexa*, new species. A. Scutum and eyes. B. Dorsal aspect of gnathosoma with chelicera, cheliceral base, galeala, and tibial setae. C. Ventral aspect of palpal tibia and tarsus. D. Coxa III, with branched setae. E. Leg I, with specialized setae (measurements in microns) and bases of branched setae of the three distal segments. F. leg II; as above. G. Leg III; as above. H. Representative body setae: PD, posterior dorsal; 1 St, first sternal; H, humeral.

Remarks. Examination of 183 larvae revealed the following variation in the number of setae on coxa III: 2-2 setae (11), 2-3 (42), 3-3 (124), and 3-4 setae (6 larvae). This is the first species of *Microtrombicula* recorded from a heteromyid host. The specific name refers to the original problem of generic placement.

Geographic distribution. Known from Guanacaste Province, Costa Rica and Boaco, Matagalpa, and Rivas, Nicaragua.

Specimens examined (195), all from *Liomys salvini*. COSTA RICA. GUANACASTE PROVINCE: 8.3 km N Liberia, 3 Aug. 1964 (1); 5 km N, 4 km W Liberia (Finca Coyo'ar), 4 Aug. 1964 (1); 7.5 km S Liberia, 8 Aug. 1964 (9 *L. salvini*; holotype + 182). NICARAGUA. BOACO: 17 km N. 15 km E Boaco, 9 Aug. 1967 (1). MATAGALPA: 1 km NE Esquipulas, 16 March 1968 (6). RIVAS: 2 km N, 3 km E Mérida, 7 April 1968 (3).

Microtrombicula starretti, new species

Figures 2, 4

Type. Larva. Holotype from 5 km SE Los Cartagos, Heredia Province, Costa Rica, off *Myotis nigricans*, black myotis, original numbers 0-2336 to 0-2350, lot (LACM 25646-60), taken 15 August 1963, by A. G. Hollister, F. G. Thompson, and A. Starrett.

Diagnosis. Larva similar to *Microtrombicula carmenae* (Brennan and Jones) and *M. sturnirae*, new species, in having two pairs of sternal setae, 3 genualae I, palpotibial claw trifurcate, and coxa III unisetose, but differing from both in having sensilla with 12 branches (2-3 branches in *M. carmenae* and 3-5 in *M. sturnirae*) and cheliceral blade with a small dorsal projection (absent in other two species).

Description of holotype. Body unengorged, 295 by 195; eyes 2/2, anterior larger, lens and ocular plate distinct.

Dorsal setae 2-6-6-6-4-4-2-2, total 32; measurements of humeral seta 46, anterior seta 37, posterior dorsal seta 37.

Ventral setae 2-2 (sternals) 4-6-8-6 + 8, total 36; measurements of anterosternal seta 22, posterosternal seta 26, posterior ventral seta 35.

Scutum: Subpentagonal, moderately punctate; sensilla flagelliform with 12 short distal branches.

Scutal measurements: AW 55, PW 65, SB 17, ASB 26, PSB 27, AP 19, AM 37, AL 26, PL 46, S 56.

Gnathosoma: Cheliceral blade with small tricuspid cap; cheliceral base and capitular sternum lightly punctate. Galeala nude. Palpal setae B/B/BBB; palpotarsus with 2 nude and 4 branched setae, and tarsala 6; palpotibial claw trifurcate.

Leg I, 3 genualae and tarsala (13); leg II, tarsala (14) and pretarsala; leg III, coxa unisetose, and 1 nude mastitarsala.

Leg measurements: I, 209; II, 193; III, 216; total, 618.

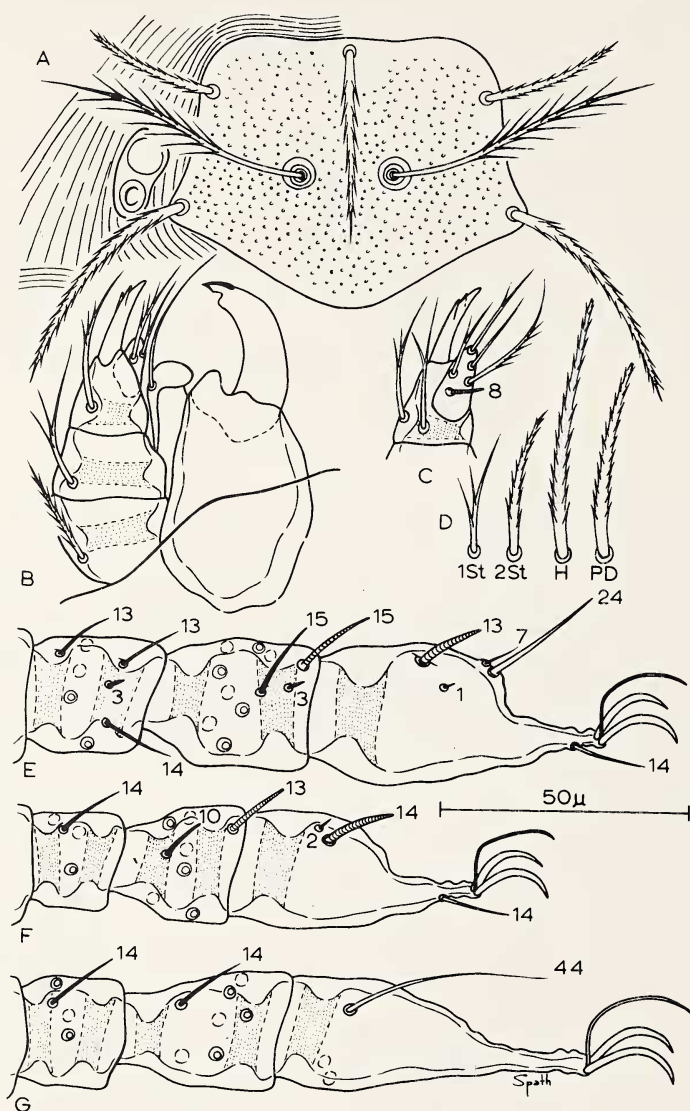


FIGURE 2. *Microtrombicula starretti*, new species. A. Scutum and eyes. B. Dorsal aspect of gnathosoma with chelicera, cheliceral base, galeala, and tibial setae. C. Ventral aspect with palpal tibia and tarsus. D. Representative body setae: 1 St, first sternal; 2 St, second sternal; H, humeral; PD, posterior dorsal. E. Leg I, with specialized setae (measurements in microns) and bases of branched setae of the three distal segments. F. Leg II; as above. G. Leg III; as above.

Ecological notes. The type host was taken near Los Cartagos (Volcan Barba) in the Montane Life Zone of the Costa Rica Highlands Biotic District (Geest and Loomis, 1968).

Microtrombicula sturnirae, new species

Figures 3, 4

Types. Larvae: Holotype and 15 paratypes from Volcán Casita, 720 m, Hda. Bellavista, Chinandega, Nicaragua, off *Sturnira lilium parvidens*, yellow-shouldered bat, original number TEL 844 (KU 106090), taken 17 July 1966 by T. E. Lawlor; and 9 paratypes from Monteverde, 1380 m, Puntarenas Province, Costa Rica, off 3 *Sturnira ludovici*, Anthony's bat, original numbers 0-2836 to-2838 (LACM 26144-46) taken 14 May 1964 by F. S. Truxal, C. A. McLaughlin, and J. M. Savage.

Diagnosis. Larva similar to *Microtrombicula carmenae* (Brennan and Jones) and *M. starretti*, new species, in having two pairs of sternal setae, 3 genualae I, palpotibial claw trifurcate, and coxa III unisetose, and differing from *M. carmenae* in having coxa III seta on or near anterodistal margin (medial, not marginal in *M. carmenae*) and from *M. starretti* in having sensilla with 3-5 branches rather than 12 branches.

Description of holotype (with mean and ranges of 8 types, holotype and 7 paratypes, in parentheses, unless otherwise noted). Body engorged, 430 by 230, eyes 2/2, distinct, nearly equal in size, separated by striae; ocular plate distinct.

Dorsal setae 2-6-6-6-6 + 10, total 36; measurements of humeral seta 36, anterior dorsal seta 32, posterior dorsal seta 42.

Ventral setae 2-2 (sternals) 4-4-4-8-8 + 10, total 42; measurements of anterosternal seta 30, posterior ventral seta 23.

Scutum: Subpentagonal, moderately punctate; sensilla flagelliform with 3-5 distal branches.

Scutal measurements: AW 36 (36, 35-38), PW 42 (44.5, 42-46), SB 13 (14, 13-14), ASB 24 (26, 24-27), PSB 21 (20, 19-21), AP 22 (23, 22-24), AM 20 (22, 20-23), AL 19 (20, 17-21), PL 34 (33.5, 31-36), S 39 (43, 39-45; 4).

Gnathosoma: Cheliceral blade with small tricuspid cap; cheliceral base with light and capitular sternum with moderate punctation. Galeala nude. Palpal setae B/B/BBB; palpotarsus with 1 nude and 5 branched setae, and tarsala 7; palpotibial claw trifurcate.

Leg I, 3 genualae, tarsala 13 (13, 12-15); leg II, tarsala 10 (11, 10-13), proximal microtarsala and pretarsala; leg III, coxa unisetose and mastitarsala with 1 long basal branch.

Leg measurements: I, 201 (198, 181-211); II, 169 (170, 147-177); III, 202 (198, 190-203); total, 572 (566, 518-580).

Remarks. Larvae from Costa Rica and Nicaragua have two branched setae on trochanter III whereas those from Mexico possess a single seta.

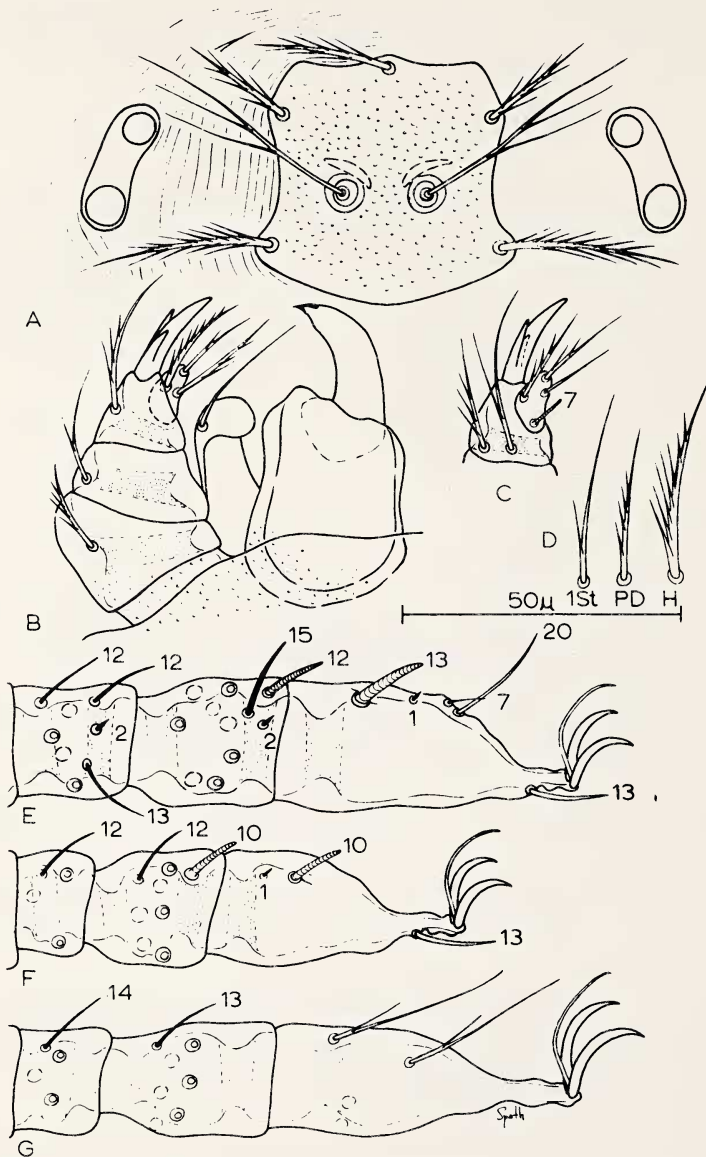


FIGURE 3. *Microtrombicula sturnirae*, new species. A. Scutum and eyes. B. Dorsal aspect of gnathosoma with chelicera, cheliceral base, galeala, and tibial setae. C. Ventral aspect of palpal tibia and tarsus. D. Representative body setae: 1 St, first sternal; PD, posterior dorsal; H, humeral. E. Leg I, with specialized setae (measurements in microns) and bases of branched setae of the three distal segments. F. Leg II; as above. G. Leg III; as above.

The larvae of *M. sturnirae* were recovered from the ears of *Sturnira lilium parvidens* taken in Nicaragua and Mexico. None of the 55 Costa Rican *S. l. parvidens* yielded this species although six of 121 *S. ludovici* and one of 12 *S. mordax* possessed numerous larvae. The bat hosts were taken from April through October.

Geographic distribution. Known from three provinces in Costa Rica, southern Sonora, Mexico, and western and central Nicaragua.

Specimens examined (73). *COSTA RICA*. CARTAGO PROVINCE: Tapantí, 30 July 1963, 2 *Sturnira ludovici* (14). HEREDIA PROVINCE: 2 km N El Ángel Falls, 18 Aug. 1964, *Sturnira mordax* (17). PUNTARENAS PROVINCE: Finca Los Helechales, 3 Oct. 1964, *S. ludovici* (2); Monteverde, 14 May 1964, *S. ludovici* (9). *MEXICO*. SONORA: 13 km SSE Alamos, Río Cuchujaquí, 10-11 April 1963, 2 *Sturnira lilium* (7). *NICARAGUA*. CHINANDEGA: Volcán Casita, Hda. Bellavista, 17 July 1966, *S. lilium* (16). CHONTALES: 1 km N, 2.5 km W Villa Somoza, 6 Aug. 1967, *S. lilium* (8).

Microtrombicula boneti (Hoffmann), NEW COMBINATION

Figure 4

Trombicula (Trombicula) boneti Hoffmann, 1952: 87, holotype from Cueva de Quintero, Tamaulipas, Mexico, host *Mormoops megalophylla*, Dec. 30, 1950; Brennan and Jones, 1959: 12.

Eltonella (Coecicula) boneti: Vercammen-Grandjean, 1965: 44.

Trombicula tibbettsi Brennan and White, 1960: 348, type from Frio Cave, Uvalde Co., Texas, host *Mormoops megalophylla senicula*, Nov. 17, 1956, NEW SYNONYMY; Brennan and Jones, 1960: 533; Goodwin and Greenhall, 1961: 204; Loomis and Crossley, 1963: 379; Brennan and Yunker, 1966: 257; Brennan, 1967: 155.

Eltonella (Coecicula) tibbettsi: Vercammen-Grandjean, 1965: 44.

Diagnosis. Larva similar to *Microtrombicula carmenae* (Brennan and Jones, *M. starretti*, new species, and *M. sturnirae*, new species, in having 3 genualae I, 2 pairs of sternal setae, and coxa III unisetose but differing from them in having palpus with pronounced lateral angulation and lacking eyes.

Description of species. Based upon 2 presumed paratopotypes: Body engorged, 370 by 265; eyes absent.

Dorsal setae 2-6-6-6-6-6-2, total 40; measurements of humeral seta (44, 45), anterior dorsal seta (38, 39), posterior dorsal seta (28, 29).

Ventral seta 2-2 (sternals) 4-6-8-6-4-4-6 + 6, total 48; measurements of anterosternal seta (35, 36), posterosternal seta (22, 26), posterior ventral seta (24, 26).

Scutum: Subpentagonal, posterior margin with acute angle; AM setal base below anterior line of AL setal bases, sensilla flagelliform with 2-4 long distal branches.

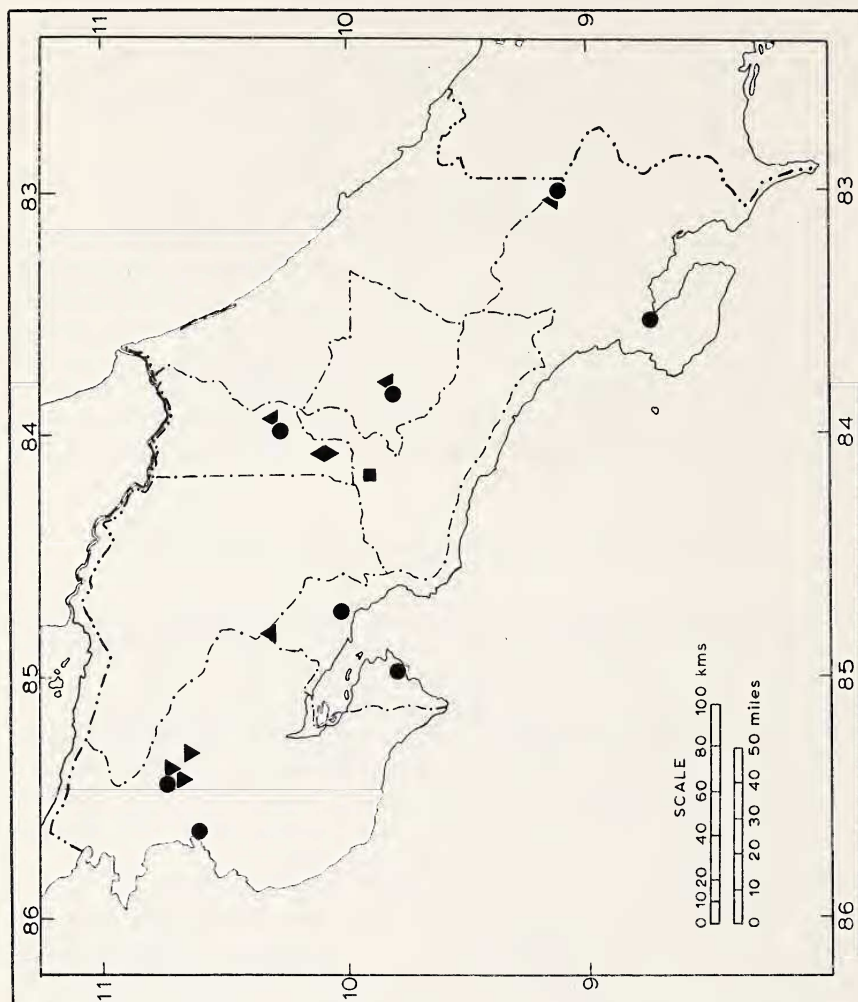


FIGURE 4. Localities of *Microtrombicula* in Costa Rica: *M. boneti* ■, *M. carmenae* ●, *M. perplexa* ▼, *M. starretti* ◆, and *M. sturnirae* ▲.

Scutal measurements: AW (57, 57), PW (70, 70), SB (20, 21), ASB (23, 26), PSB (26, 26), AP (19, 23), AM (36, 39), AL (27, 27), PL (38, 46), S (48, —).

Gnathosoma: Cheliceral blade with medium sized tricuspid cap. Galeala stout with several branches. Palpal setae B/B/BNB; palpotarsus with 1 nude or nearly nude and 5 branched setae, and tarsala; palpotibial claw trifurcate.

Leg I, 3 genualae and tarsala (17, 17); leg II, tarsala (12, 12) and pretarsala; leg III, coxa unisetose, and 1 nude mastitarsala.

Leg measurements: I (197, 215); II (168, 181); III (189, 197); total (554, 593).

Taxonomic remarks. The types of *Trombicula boneti* were from *Mormoops megalophylla*, a phyllostomatid bat, taken in northeastern Mexico. *Trombicula tibbettsi* Brennan and White (1960) was based upon larvae from Texas recovered from the same host species, as well as from several other species of bats taken in Alabama and Trinidad. Vercammen-Grandjean (1965) placed them in the genus *Eltonella*, subgenus *Coecicula*, and separated the two species on the basis of the number of body setae. A study of the original description and two presumed paratypes (RML) of *T. boneti* revealed 32-40 dorsal body setae and 34-38 ventral body setae. These counts overlap those of the original description and of four larvae of *T. tibbettsi* (RML) with dorsal setae numbering 28-34 and ventral body setae 36-42. In addition, a careful comparison of other characteristics, including the scutal shape, acute palpal angulation, lack of eyes, two pairs of sternal setae, and the 2-5 distal branches on the sensillae, has led to the conclusion that all of these larvae belong to the single species, *M. boneti*.

Vercammen-Grandjean (1965) reported that the eight larvae of *M. boneti* from Uvalde Co., Texas had shorter legs than two larvae from San Jose Province, Costa Rica. Selected scutal measurements of the same two specimens from Costa Rica (RML) and 10 larvae from La Aduana, Sonora, México, also revealed a larger size for the Costa Rican specimens. The ten larvae from Sonora, México measured: AW 57, 56-58; PW 73, 71-78; SB 21, 19-22; PL 46, 43-50. The two specimens from Costa Rica measured: AW 66, 65-67; PW 88, 87-89; SB 27, 27; PL 47, 46-48.

Ecological notes. Larvae of *M. boneti* have been recovered from the wings of natalid, phyllostomatid and vespertilionid bats.

Geographic distribution. Known from Alabama and southwestern Texas, Mexico (Cape Region of Baja California, southern Sonora, Sinaloa, Tamaulipas, southward to Chiapas), Costa Rica (San José Province), Panama, Curaçao, and Trinidad.

Specimens examined (50). **COSTA RICA.** SAN JOSÉ PROVINCE: Rock Cave, W of Santa Ana, *Desmodus rotundus* (2, RML). **MEXICO.** BAJA CALIFORNIA SUR: 5 km SE Pescadero, 10 July 1963, *Natalus stramineus* (8). CHIAPAS: 3 km N Las Margaritas, 23 July 1964, *D. rotundus* (1). SONORA: 1 km SW La Aduana, 6 Aug. 1963, *Leptonycteris sanborni* (28); La Aduana, 7 Aug. 1964, *Glossophaga soricina* (2). SINALOA: 2 km SW Santa Lucia, 28 July 1963, *Mormoops megalophylla* (4); 1.5 km W Copala, 29 July 1963, *Pteronotus parnellii* (1). TAMAULIPAS: Cueva de Quintero, 30 Dec. 1950, *M. megalophylla* (2, RML). **TEXAS.** Uvalde Co.: Frio Cave, 22 Jan. 1956, *M. megalophylla* (3).

Additional records. **PANAMA** (Brennan and Yunker, 1966). PANAMA: Chilibre, Chilibre Caves, 2 Aug. 1960, *Pteronotus suapurensis* (1). **ALABAMA** (Brennan and White, 1960). Conecuh Co.: Sanders Cave, 9 Aug. 1953, *Myotis grisescens* (1); Lauderdale Co.: Collier Cave, 27 Sept. 1953, *M. grisescens* (1). **TEXAS** (Brennan and White, 1960). Uvalde Co.:

Frio Cave, 17 Nov. 1956, *Mormoops megalophylla senicula* (3). WEST INDIES. Bahama Isl. (Brennan, 1967), New Providence: Hunt's Cave, 22 Aug. 1949, *Erophylla sezekorni* (1). CURACAO (Brennan, 1967): Cave of Hato, 22 Dec. 1950, *Glossophaga elongata* (1). TRINIDAD (Brennan and White, 1960 and/or Brennan and Jones, 1960), St. Andrew Co.: Tamana Hill Cave, 12 June 1956, 3 *Chilonycteris rubiginosa rubiginosa* (16), 20 Nov. 1957, *Mormoops tumidiceps* (5), *M. megalophylla* (4).

Microtrombicula carmenae (Brennan and Jones), NEW COMBINATION

Figure 4

Trombicula carmenae Brennan and Jones, 1960: 512, holotype from Emperor Valley Zoo, Port of Spain, St. George Co., Trinidad, host *Phyllostomus discolor*; Goodwin and Greenhall, 1961: 204; Brennan and Yunker, 1966: 253.

Eltonella (*Eltonella*) *carmenae*, Vercammen-Grandjean, 1965: 44.

Diagnosis. Larva similar to *Microtrombicula starretti* new species, and *M. sturnirae* new species, in having coxa III unisetose, 2 pairs of sternal setae, 3 genualae I, and palpotibial claw trifurcate, and differing from *M. starretti* in having sensilla with 2-3 branches (*M. starretti* with 12 branches) and from *M. sturnirae* in having coxa III medial, not marginal (on or near anterodistal margin in *M. sturnirae*).

Description of species (based on the holotype after Brennan and Jones, 1960, 1 paratype, 3 referred slides from RML and specimens examined). Body partly engorged, 465 by 300; eyes 2/2, anterior lens larger or equal in size with posterior lens, no ocular plate.

Dorsal setae 2-6-6-6-4-2-2, total 28; measurements (paratype) of humeral seta 37, anterior dorsal seta 37, posterior dorsal seta 32.

Ventral setae (paratype) 2-2 (sternals) 4-2-6-6-4-4, total 30; measurements of anterosternal seta 22, posterosternal seta 23, anterior ventral seta 22, posterior ventral seta 29.

Scutum: Subpentagonal, lightly punctate; sensilla flagelliform with 2-3 long distal branches.

Scutal measurements (1 paratype in parentheses): AW 48 (46), PW 60 (58), SB 18 (15), ASB 26 (24), PSB 20 (21), AP 21 (21), AM 31 (28), AL 23, (21), PL 36 (35), S 44 (39). Scutal measurements including the mean and range of selected samples (in parentheses): Costa Rica (11): AW 45, 42-49; PW 55, 53-57; SB 15, 15-16; ASB 23, 22-27; PSB 23, 20-24; AP 23, 21-26; AM 30, 27-32 (10); AL 22, 20-24; PL 36, 34-39. Nicaragua (11): AW 49, 46-50; PW 58, 57-59; SB 16, 15-19; ASB 26, 23-29; PSB 25.5, 24-27; AP 25, 22-27; AM 30, 24-32 (9); AL 24, 23-27; PL 40, 47-42. Oaxaca, Mexico (10): AW 49, 46-53 (8); PW 62, 56-70 (9); SB 17, 15-19 (9); ASB 26, 24-30 (9); PSB 25, 23-28 (9); AP 25, 22-28; AM 29, 24-31 (5); AL 24, 22-27; PL 39, 34-42 (6).

Gnathosoma: Cheliceral blade with small tricuspid cap; cheliceral base

and capitular sternum moderately punctate. Galeala nude. Palpal setae B/B/BNB (paratype exhibited lateral palpotibial seta with several small branches and ventral palpotibial seta forked); palpotarsus with 1 nude and 5 branched setae, and tarsala; palpotibial claw trifurcate.

Legs (measurements of 1 paratype in parentheses): Leg I, 3 genualae and tarsala 13 (14); leg II, tarsala 11 (10) and pretarsala; leg III, coxa unisetose, and 1 nude (sometimes with 1-3 barbs) mastitarsala. Measurements of tarsala I and II with means and extremes of 30 larvae from the bat host, *Artibeus jamaicensis*: Costa Rica (10): T_I 15, 13-17; T_{II} 11.5, 10-13. Nicaragua (10): T_I 15, 14-16; T_{II} 12, 10-13. Oaxaca, Mexico (10): T_I 15, 14-16; T_{II} 12, 10-13.

Leg measurements of 1 paratype: I, 213; II, 180; III, 212; Total, 605.

Ecological notes. Specimens of *M. carmenae* and *M. sturnirae* have been taken from the same individual host and from different hosts at the same locality in Costa Rica. Larvae are recorded from all months except January, February, May and December.

Geographic distribution. Known from eastern Oaxaca, Mexico, Nicaragua, Costa Rica, Panama, and Trinidad.

Specimens examined (151). *COSTA RICA*. CARTAGO PROVINCE: Tapantí, 30 July 1963, *Sturnira ludovici* (1). GUANACASTE PROVINCE: Bahía del Coco, 19 July 1962, *Phyllostomus discolor* (2); 9 km N Liberia, 15 July 1962, *Artibeus jamaicensis* (1); Playas del Coco, 20-23 July 1962, 3 *A. jamaicensis* (3), 3-4 April 1963, 2 *A. jamaicensis* (17). *HEREDIA PROVINCE*: 2 km N El Angel Falls, 18 Aug. 1964, *Sturnira mordax* (6). *PUNTARENAS PROVINCE*: Boca de Barranca, 1 Aug. 1962, *P. discolor* (1); Finca Don Nicholas, 3 km N Tambor, 14 Nov. 1964, 2 *P. discolor* (5); Finca Los Helechales, 4 Oct. 1964, *A. jamaicensis* (6); Rincón, Osa Peninsula, 28 June 1963, *Artibeus lituratus* (1), 3 July 1963, *A. lituratus* (5). *MEXICO*. OAXACA: Las Minas (8 km E Tapanatepec), 10 June 1964, 2 *A. jamaicensis* (21). *NICARAGUA*. BOACO: 14 km S Boaco, 18 July 1964, *P. discolor* (9). CARAZO: 3 km N, 4 km W Diriamba, 12 Aug. 1967, *A. jamaicensis* (1). *GRANADA*: Finca El Progreso, 10 km SE Guanacaste, 15 June 1966, *P. discolor* (15). *JINOTEGA*: Yali, 4 Aug. 1966, *A. jamaicensis* (16). *MANAGUA*: 2 km N Sabana Grande, 11 June 1966, 2 *P. discolor* (5). *NUEVA SEGOVIA*: 2 km N, 1 km E Jalapa, 24-27 July 1967, 4 *A. jamaicensis* (21). *RIVAS*: 3 km N, 4 km W Sapoa, 24 June 1966, *Desmodus rotundus* (11). *PANAMA*. PANAMA: Pacora, 6 June 1961, *Phyllostomus hastatus* (1). *WEST INDIES*. *TRINIDAD*, Mayaro Co.: Point Radix, 24 April 1959, *D. rotundus* (1). *St. Andrew Co.*: Sangre Grande, 16 April 1959, *D. rotundus* (1). *St. George Co.*: Emperor Valley Zoo, Port of Spain, 14 March 1958, *P. discolor* (1 paratype, RML).

Additional records (Brennan and Yunker, 1966). *PANAMA*. BOCAS DEL TORO: Rio Changena, 19 Sept. 1961, *Artibeus jamaicensis* (4), *Sturnira ludovici* (1).

KEY TO THE LARVAE OF *MICROTROMBICULA* FROM COSTA RICA

1. Two genualae I; sternal setae 2-2-2; sensilla slightly expanded;
coxa III with 2-4 setae (from *Liomys salvini*) *M. perplexa*
Three genualae I; sternal setae 2-2; sensilla flagelliform;
coxa III unisetose (from bats) 2
2. Palpus with pronounced lateral angle, tarsus III with medial
whorl of 4 setae *M. boneti*
Palpus without pronounced lateral angle, tarsus III with
medial whorl of 5 setae 3
3. ASB > PSB, coxa III seta on anterodistal margin (from
Sturnira species) *M. sturnirae*
ASB $\cong$ PSB, coxa III seta medial, not marginal 4
4. Sensilla with 2-3 branches, proximal mastitarsala III with
1-3 barbs *M. carmenae*
Sensilla with 10-12 branches, proximal mastitarsala III nude
(from *Myotis nigricans*) *M. starretti*

RESUMEN

Cinco especies de *Microtrombicula* se reportan por primera vez de Costa Rica: *M. perplexa*, especie nueva, tipo hospedero *Liomys salvini*, de la provincia de Guanacaste, Costa Rica, y de Nicaragua; *M. starretti*, especie nueva, tipo hospedero *Myotis nigricans*, de la provincia de Heredia, Costa Rica; *M. sturnirae*, especie nueva, tipo hospedero *Sturnira lilium*, de Chinandega, Nicaragua, Costa Rica, y México; *M. boneti* (Hoffmann) COMBINACIÓN NUEVA (*Trombicula tibbettsi* Brennan y White, SINÓNIMIA NUEVA) de los murciélagos del sur de los Estados Unidos hasta Trinidad; y *M. carmenae* (Brennan y Jones) COMBINACIÓN NUEVA de los murciélagos de sur de México hasta Trinidad. Una clave de las larvas está incluida.

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